The ship-generated waste and cargo residues MARPOL I recovery after the Directive 2000/59/EC on port reception facilities. A national approach

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This paper addresses the issue of uncertainty in ship-generated hydrocarbon waste collection data from the time of the Directive 2000/59/EC publication to, the year 2005. The starting point was an in-deep analysis of the Directive when the EU Environmental law was published and continued with the monitoring of the decision making process of the Royal Decree in Spain as Member State. Then, the aim was to find data about the amount of oil waste generated by ships. Firstly, amount of oil waste generation as EU official data was searched. Secondly, after having found little significant data, a general research of oil waste quantities on port reception facilities and at sea spillages was done. Finally, a way of performing a calculation to theoretically estimate the oil waste amounts is suggested. All this process allows to: first realize the long and slow way a new international law creation carries along. And second how far Spain still is from the European levels of vessel oil waste management, specifically the oil waste described in Attached document I to MARPOL international agreement.

1. INTRODUCTION. During the year 2002, an study[1] was carried out in Spain on the amount of vessel oil waste collected at the waste collecting installations in the ports. The objective of such study was to collect, across all the ports in the country, the MARPOL I waste volumes received at the port installations during a year. The lack of either unified information or standardised collecting processes obligated to develop a laborious task: visiting all the ports and asking the installations how much waste they had collected during the year before. That means every single MARPOL waste operator was contacted but that does not mean every single port was contacted since in many cases a single agent operates in more than one port. The objective was to collect the MARPOL I

waste quantities all around the country in a single chart for the year 2001 together with an updated list of the MARPOL waste operators working in each port and the kind of installation and service offered in each one. Another related objective was to confirm that the oil waste proportion received at the different installations was definitely low, in many cases it did not even match with the traffic volume registered or managed by the port.

Before the above mentioned Directive, Port Reception Facilities (PRF) were operating under the Spanish Royal Decree 438/1994 accomplishing the MARPOL International Agreement 73/78. Decree stated that Captains are obligated to declare the type of residues that they carry on board but these do no need to be delivered. This common normative for all Member States according to "A Common Policy on Safe Seas" communicated by the proper Commission of the European Community one year before[2] expected a significant contribution in reducing the pollution into the sea from vessels and avoid the laxity in the application of environmental regulations that it had been perceived since then between the Member States. It must be pointed out that the common policy or common market established in the framework of the EEC then was when the "Treaty of Rome" was signed in 1957 but it did not contain any specific environmental policy for this Community. The first Environmental Action Programme where the EC took action to introduce legislation to protect marine environment was in 1973 in which principles in dealing with pollution-prevention were established.

EU law, following international laws, demand installations to be regulated following the MARPOL agreement. At the same time the MARPOL agreement requires that member states ensure the provision of reception facilities which should be adequate to meet the needs of vessels normally using those ports and whose use should not unduly delay the vessel. However this point of view changed when the EU Diary published the Directive 2000/59/CE in the year 2000 where two new important basic considerations were settled:

- All the vessel waste, included those from the cargo, have to be delivered at the port.
- All the vessels have to economically contribute in the installations maintenance.

After entering in force this directive, every signing government had two years to adapt the directive, performing the needed works and studies.
The new Directive had been worked on since 1998. Two years of previous work, meetings with the government delegates to define what the minimum exigencies were going to be for them to accomplish later. This was a slow and long process with the only objective of finally define an

accurate, reachable, practicable and, at the same time, demanding law. Each governmental subsequent work was, on a minimum basis, to adapt the directive points to the national laws or, in the adaptation process, to empower and widen the directive demands. This process took two years and was performed in each country by a work group headed by the Permanent Representation to the European Union in Brussels (REPER) or corresponding government delegates plus the involved members such as ports, shipping companies and MARPOL agents among others. By holding periodical meetings they studied the directive from the beginning to the end, trying to find the way for it to enhance fit for the moment of putting it into practice.

Regarding Spain, the Royal Decree endorsing the EU directive started in 2002, carrying along considerably empowering and widening the directive demands. At that moment, an in deep study about how the process had been performed was done. This process brought a wide knowledge about each directive article. It also brought the understanding about how an international rule can affect a national one and interfere with other local regulations.

Mainly, Installations and vessels had to adapt themselves to the new law after the Directive came into force in Spain in 2002 as the Royal Decree 1281/2002. In 2005, since the directive had, in theory, a level of maturity all across Europe, a similar to the Spanish original study was engaged, id est the data compilation of the MARPOL I waste amount collected at the PRF along one full year.

2. THE AMOUNT OF OIL WASTE FROM VESSELS IN EUROPE AND SPAIN, ANALYSIS.

The aim of this study was to obtain specific data about the amount of oil waste deployed in Port Reception Facilities (PRF) by vessels. That is, what amount these installations are receiving within European territory. Once this data is achieved, it could be compared with the number of vessels operating across the European ports. A calculation of the amount of waste from vessels can be done, but that means an approximate estimation of the oil waste generated by vessels amount is possible. The quantities generated by vessels less the amount received by the PRF should be zero, or may be a very low figure, since the data is not exact but an approximation. However, the nowadays result of this calculation is a very high positive figure.

The explanation for this difference comes mainly from the data of the oil waste received by the PRF. Vessel oil waste generation is an approximate calculation, but it is an estimation at the end more than a lucubration. However, receptions by the PRFs figures are not accurate and, in most cases, they do not match the traffic volume registered at each port.

After the new Directive 2000/59/EU was implemented, it was commonly thought this subtraction could be done with no problem, and the specific oil waste figures could be found. Since the new law forces all the vessels to deploy their oil waste in PRFs (among other new requirements) it is not difficult to suppose that both figures should match. However, the final result is still casting new shadows on where part of the oil waste actually goes.

2.1. OIL WASTE GENERATED.

a) WITHIN EUROPE.

Firstly the intention was to search oil waste quantities generated from vessels in Europe according to European Community data. An estimation of this ship generated waste was found in Europe since, the European Community had published rough amount in 1997. The figures were referenced to the total quantity of oil residues generated in Europe and from all vessels traffic.

Table 1 Oil residues generated in Europe from all vessels:

It has been calculated that, in general, only the 7% of oily waste is delivered on PRF, that means around 18.6 millions Tonnes are not registered each year.

b) AROUND SPAIN.

The European Community data for Spain showed that heavy oil traffic could generate 3.5 millions Tonnes of residues but, only slops and other remaining oil could reach quantities up to 250,000 Tonnes. These estimations did not include either residue from sewage bilge, waste oils and fuels or other transport generated residues from oil such as petrol or benzene. It is possible to assume that ports generated waste could exceed 3.68 million Tonnes per year. If 25% (quantity approximated that is deployed on port facilities) is subtracted from this among, it would be found the destination of near 2.62 millions Tonnes of oil waste it is unknown.

3. OIL WASTE QUANTITIES ON PORT RECEPTION FACILITIES.

After having analyzed oil waste generated from ships it seems that delivery of ship-generated waste could offer other data. The number of vessels arriving at European harbours and the residues generated by them, could suppose that PRF should receive more than 22 millions m^3 per year. Nonetheless, in reality the quantities are much lower. It is still difficult to find exact data due to the PRF quantities received are difficult to obtain and there is no homogenized system, but it is possible to estimate that this PRF are receiving a extremely low amount of that so-called annual quantity.

a) WITHIN EUROPE.

Rotterdam is the harbour exchanging more commodities in Europe with 320 millions of Tonnes per year[3] but only 7% of the ships berthing were delivering their MARPOL I residues. This figure corresponds to 1% from engine room and 3% of diesel oil waste.

b) AROUND SPAIN.

It seems that in Spain something similar occurs. In 2003, the Ministry of Public Works reported[4], one year after the Algeciras Bay Special Plan started and with the Directive implemented, that oil residues received on port were 200,000 m^3. However, the EU classified Spain according to the traffic volume[5], as the 14th position in Europe's ranking, receiving 4% volume in Europe hydrocarbons[6] and that represents the reception of oil waste should be more than four times that figure, which means more than 800 thousand m^3.

3.1. LIQUID OIL PRODUCTS FROM SEA SPILLAGES.

A general overview has been offered until now about oil waste generated by ships and quantities received on port reception facilities, observing a great mismatch between both. It could help to know how much oil are floating in the oceans as slicks in order to understand where oil waste is going. Approximate calculations of the yearly amount of hydrocarbons derivates being spilled to the sea have been made. These spills are done both from the vessels while they are sailing close to and from the coast industrial activities, though not in the same proportion. Liquid petroleum derivate products spilled from navigating vessels are produced just because of the fact that vessels carry petroleum and because of the "normal activity" of the worldwide merchant fleet due to everyday engine's running. These spills can also have different origins, for instance they can be accidental (several different origins) or intentional (because of financial reasons or environmental disrespectful actions).

3.1.1. ACCIDENTS.

During the last 30 years about 50 accidents have spilled more than 7 Tonnes of oil per year by average in world's seas. About 250 minor accidents[7] have happened per year as well, meaning almost one accident per day and spilling between 240,000 and 960,000 Tonnes of hydrocarbons. Obviously, not all of these accidents have been shown by the media, but only those we know because of their environmental impact. The European waters have experimented well known cases such as *Urquiola, Torrey Canyon, Amoco Cádiz, Sea Empress, Betelgeuse, Braer, Haven, Agean*

Sea, Erika or Prestige among others. All together they have contributed to the total amount of oil at sea by a statistical figure of 12 % per year.

Worldwide fleet results: **between 240,000 and 960,000 Tonnes/year of oil spilled to the sea** Europe fleet results: 500.000 Tonnes/year

3.1.2. ROUTINE OPERATIONS.

The amount of oil spilled at sea from oil tankers across the Mediterranean Sea is estimated at 600,000 Tonnes hydrocarbons per year[8]. The total worldwide, because of routine operations from tanker vessels, is equivalent to something between 666,000 and 2,640,000 Tonnes (this is per year and it can be pointed out that a large excessive interval figure is done). This figure is 2.75 times the spill because of accidents, or between 8 and 33 times the spill because of the Prestige. These figures include spills because of illegal open sea tank washing; some oil vessels can generate 800 Tonnes of waste per cargo. There are other amount ascribed to other type of ships such as fishing, leisure and military adding thousands of Tonnes to the sea pollution. These are produced by the bilges, used oils, oiled waters, bunkering and other products containing oil, estimating these about 280,000 Tonnes per year[9]. This is more than 2,000,000 oil barrels, or as much as the daily production of Venezuela (the third OPEC producing country).

Worldwide fleet results: **between 666,000 and 2,640,000 Tonnes /year of oil spilled to the sea** Europe fleet results: 623,000Tonnes/year

3.2. WASTE FROM THE VESSELS CARRYING OIL IN TRANSIT.

Crude oil transport is 35 % of worldwide total transport and refined oil[10] is 10 % of total. This is something between 1,600 and 1,800 million of Tonnes of oil and between 400 and 500 million of Tonnes of refined oil[11]. More than 50 %[12] of this goes to the USA and the EU. Apart from the traffic going to European ports, European waters are also crossed by vessels carrying goods to other places. Every year, the Mediterranean Sea is crossed by thousands of oil tankers carrying oil from the Persian Gulf to the USA. The Strait of Gibraltar registers annually about 18,000 vessels carrying dangerous cargo and all this increases the oil tonnage in European waters by more than 1,000 million Tonnes per year.

To carry all these amounts, different size vessels are used, from less than 5,000 GRT, mainly for transportation between EU ports, to ultra large sized vessels of more than 120,000 GRT or even ultra large vessels of more than 300,000 GRT for trans-ocean navigation. The average size is between 40 and 45 GRT[13] carrying circa to 80,000 Tonnes. This allows estimating between 1,500 and 2,000, gas, tanker, and chemical vessels carrying products across Europe every year, each of them visiting several European ports and unloading between 10,000 to 25,000 Tonnes of oil at each refinery by average.

a) WITHIN EUROPE.

Europe is the main oil receiver with about 500 million of Tonnes of crude oil per year and between 250 to 300 million of Tonnes of refined oil. That means almost one quarter of the world wide oil production.

This trade distribution in European waters[14] can be outlined as following:

Table 2 Trade distribution in European waters:

b) AROUND SPAIN.

The Iberian Peninsula is in the middle of two main oil entrances to Europe. Firstly there is the Atlantic and Bay of Biscay areas where vessels going to and coming from the USA, Africa, Asia and Oceania; this area is also in the middle of the route between north and south Europe. Secondly, the Mediterranean waters, where all vessels going to or coming from the Suez Canal pass through, and also for the trade between southern Europe and the rest of the world. Spanish ports records 12 % of goods trade in Europe (circa 354 million Tonnes per year). Regarding oil, the figures are almost 120 million Tonnes per year. Almost one half is crude oil, the rest being fuel-oil, gas-oil, gasoline and others[15]. It can be said 70% are heavy hydrocarbons, meaning non-refined oil, fuel-oil and asphalt.

3.3. HOW THE PRODUCTION OF OIL RESIDUES GENERATED BY OIL TRANSPORTATION CAN BE ASSESSED.

It is estimated that the arrival and global movement of oil tankers is 500 million of tonnes of crude annually. This quantity must be added to the internal transport of the crude oil and its derivates, which increases the figure up to 800 million tonnes. The oil waste quantities generated by this maritime traffic are estimated too.

The European Union carried out a research in 1997[16] in order to identify the scale of the oil waste quantities and the port reception facilities capacity. The oil waste generated by ships can be calculated according to specific values called guide-MARPOL that the IMO carry out. The IMO takes into account the following parameters. These parameters can allow calculations of the residues generated by vessel which carry hydrocarbon every year in Europe.

Tanker vessels, related with its total cargo volume:

4.8% cleaning water

0.2% crude oil or cargo waste

0.01 to 0.1% semisolid cargo residues

Vessels with diesel propulsion:

2 to 3% mud from daily consumption of fuel

Oil waste generated from vessels related to the used fuel:

1.5 to 2% for heavy fuel

0.5% for diesel

Taking into account theses values guide-MARPOL the oily waste generated by tanker ships fleet would be:

Table 3 The oil waste quantities generated by European maritime traffic:

However, these statistics do not include other oil waste from fuel consumption or bilge oils.

Taking as an exemple the 2,000 oil tank vessels sailing around Europe every year a calculation of the oil waste generated according to the average IMO parameter can be done.

A merchant ship burns 0.35 tonnes of fuel per GRT and per year[17], on average. For this reason, a medium sized tanker vessel of 45,000 GRT could consume 15,750 Tonnes of fuel per year.

$$\frac{0.35\ combustible\ Tonnes}{1\ GRT * 1\ vessel * 1\ year} * 45{,}000\ GRT = \frac{15{,}750\ combustible\ Tonnes}{1\ vessel * 1\ year}$$

The showed relationship on residues generation per fuel tonne is applied, obtaining that a medium sized oil tanker generate 315 Tonnes of residues per year only because its own bunker consumption.

$$\frac{15{,}750\ combustible\ Tonnes}{1\ vessel * 1\ year} * \frac{2\ residues\ Tonnes}{100\ combustible\ Tonnes} = \frac{315\ residues\ Tonnes}{1\ vessel * 1\ year}$$

Considering the 2,000 oil tanker vessels sailing around Europe annually means they consume 31.5 million Tonnes of fuel generating which have generated 630,000 Tonnes of residue per year.

$$\frac{315\ residues\ Tonnes}{1\ vessel * 1\ year} * 2{,}000\ vessels = \frac{630{,}000\ residues\ Tonnes}{1\ year}$$

This brief assessment shows that it is possible to calculate oil residues generated by vessels. However, the quantities generated by all of them, can be a difficult process and it may not offer reliable data. It is not only a matter of calculating the average residue a vessel engine can generate but of taking into account the storage capacity and the mitigation capacity among many other variables.

4 CONCLUSIONS AND FURTHER WORK. Studying the process of a national regulation transposition from an International law, in this case the EU framework through the MARPOL 73/78 Convention, to a national law has illustrated the complex nature of the legislative process development. The whole process took 6 years in total, 2 years under study, 2 years for the transposition and 2 years for offering instructions about how the Directive principles had to be interpreted and put into practice.

But it is also useful to realize that law effectiveness is a long process requiring time to pass, probably more than 5 years to be able to see some results in this case. Even more, during the law adaptation process, new supporting laws as ministerial orders can be required for instance, the regulation (EC) No. 2099/2002 establishing a Committee on Safe Seas. Then, it also serves to illustrate that EU Environmental legislation should no remain static but needs to respond to changes in knowledge and to developments.

The obtained figures indicate that the overall picture shows to be very complex, scattered and, in some cases, confused hence the system needs to improve from each side. Mainly from the side of ships, as they have to be conscious to leave their MARPOL I waste to the installations. It is not

enough to see that after 3 years of a new law implementation (that is in 2005); only between 6 and 10% of the merchant vessels waste generated in Spanish waters is managed by the PRF.
Incentives to deliver waste on port reception facilities and in addition the sanctions system has to continue being implemented even enhance economically.

However, competent Authorities of MS Representatives of Port must play an important function. The need to have data on the waste quantities received by ports means that Port Authorities must gathering information dealing with ships and agents on one side and operators on the other side. At the same time, MSs have to collect this information and to report reliable statistics to the European Commission (COM). A listing of Authorized PRF should be published and diffuse besides detailed and clear transposing measures and clear guidelines, in accordance with the principles of The Directive.

MSs could increase both the surveillance and inspections on ports and organise official meetings with the stakeholders (ships, shipping agents, waste operators and environmental authorities) concerning the implementation of the Directives and the control of the marine pollution.
Pollution prevention requires the effort of all the States and should be discussed at IMO and other worldwide forum in order to avoid the absence of most of the main oil producers as the main international agreements (e.g. MARPOL) signing members.

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